

REMARKS

In response to the above Office Action, enclosed is a proposed correction to FIG. 1 and a Replacement Drawing including the correction.

In addition, claim 1 has been amended to make it clear that the warp and weft yarns of the glass cloth are of the same kind of glass yarn and to include the limitations of claim 3 and claim 3 amended to more specifically define the invention. Support for the amendment to claim 3 can be found in paragraph [0025].

Claim 2 has been cancelled and replaced by a new claim 6 dependent from claim 1 or 3 relating to the method step set forth in claim 2.

In the Office Action, the Examiner rejected claims 1, 2, and 5 under 35 U.S.C. §102(b) for being anticipated by or in the alternative under 35 U.S.C. §103(a) for being obvious over U.S. Patent No. 5,236,777 to Inoguchi et al., hereafter Inoguchi. Claims 3 and 4 were rejected under 35 U.S.C. §103(a) for being obvious over Inoguchi in view of U.S. Patent No. 5,100,722 to Nakamura et al., hereafter Nakamura.

Claims 1, 2, and 5 were also rejected under 35 U.S.C. §103(a) for being obvious over Inoguchi in view of U.S. Patent No. 3,571,871 to Caroselli. Claims 3 and 4 were similarly rejected over Inoguchi, Nakamura, and Caroselli.

Since the limitations of claim 3 have been incorporated into claim 1, it is believed the rejections under §102(a) and under §103(a) based on Inoguchi are now moot. So also is the rejection under §103(a) based on Inoguchi in view of Caroselli. Their withdrawal as grounds of rejection of the claims is, therefore, requested.

(1) The Present Invention

The glass cloth of the present invention meets the following requirements:

(a) the glass cloth is composed of warp yarns and weft yarns of the same kind of glass yarn;

(b) the thickness thereof is not less than 10 μm and not more than 50 μm ;

(c) the ratio of warp yarn width to weft yarn width is not less than 0.80 and not more than 1.20; and

(d) the ratio of the elongation rate in a length direction to the elongation rate in a width direction is not less than 0.80 and not more than 1.20.

The film substrate of claim 5 composed of one sheet of the glass cloth of claim 1 and a matrix resin has little anisotropy in the ratio of the dimensional change in the XY directions and thus has little warpage (see Table 1 on page 33 of the specification).

Thus, it is suitable for use as a flexible substrate.

The glass cloth of claim 1 can be produced by the method of claim 6 having the step of a flattening process under a very low tension, which is not more than 49 N per 1 m width of the glass cloth compared with conventional technology.

The inventors believe this glass cloth has been produced for the first time as explained below.

Glass cloth is produced as a long fabric with a tension being exerted on the warp yarn. Under this condition, no tension is exerted on the weft yarn. Therefore, the shapes of the warp yarn and the weft yarn, which are represented by the width and waviness of the cross-section of the fabric, are not the same in the fabric. This is described later on more specifically.

In the case of a thin glass cloth whose thickness is not less than 10 μm and not more than 50 μm , the difference between the shapes of the warp and weft yarns is more remarkable than in the case of a thicker glass cloth. This is considered to be caused by the higher tension exerted on the warp yarn during weaving or a fiber-opening treatment. As a result of investigation, the present inventors discovered that a large decrease in tension during weaving and a fiber-opening treatment makes the shapes of warp yarns and weft yarns the same as each other.

However, it is difficult for the conventional weaving machine to weave at a sufficiently low enough tension to produce this advantageous effect. This problem can be solved by introducing tension control in a step of a flattening process, which enables the glass cloth to be conveyed under low tension. Thus the inventors could obtain the glass cloth described in amended claim 1. Therefore, when there is no description of the glass cloth being conveyed under a low tension, the glass cloth would have been produced by conventional technology and a glass cloth produced by conventional technology cannot fulfill the requirements of both (c) and (d) above at the same time.

(2) The difference between conventional technology and the present invention

Conventional technology is explained below based on WO00/60153A1 (hereafter WO'153) which corresponds to EP1176239A1 which was cited in the International Search Report and in the Information Disclosure Statement filed March 18, 2005.

WO'153 describes glass cloth for a print interconnection substrate, which is suitable for making uniform small-diameter holes. More specifically, it describes four Examples and two Comparative Examples as shown in the following table. Occupancy in the table means the ratio of the measured weft yarn width or the warp yarn width to

the theoretical yarn width per piece of yarn which is calculated from fabric density. For example, when the fabric density is 60 pieces/25 mm, the occupancy is $25000/60 = 417 \mu\text{m}$.

Sample	Thickness	The kind of yarn	Weft yarn width (occupancy)	Warp yarn width (occupancy)	Warp yarn width /weft yarn width
Example 1	28 μm	Same	352 μm (97%)	161 μm (44%)	<u>0.46</u>
Example 2	30 μm	Same	354 μm (98%)	204 μm (56%)	<u>0.58</u>
Example 3	32 μm	Same	356 μm (98%)	214 μm (59%)	<u>0.60</u>
Example 4	42 μm	Same	464 μm (100%)	386 μm (83%)	<u>0.83</u>
Comparative Example 1	<u>55 μm</u>	Same	350 μm (64%)	264 μm (63%)	<u>0.75</u>
Comparative Example 2	<u>38 μm</u>	Same	285 μm (64%)	199 μm (45%)	<u>0.70</u>

Comparative Examples 1 and 2 in the above table show the measurement values of glass cloth produced by the conventional method. The reason the weft yarn width is larger than the warp yarn width, is caused by the fact that no tension was exerted on the weft yarn while a given tension was exerted on the warp yarn due to the winding roll during weaving. That is, a yarn is an aggregation of a plurality of filaments, so that the cross-sectional shape of the warp yarn is more likely to be a circular shape as a result of a tendency toward linear arrangement of each filament of the warp yarn tensed. On the contrary, the cross-sectional shape of the weft yarn which is not tensed is has a flattened ellipse shape by the weaving and the winding roll. Therefore, this glass cloth has the relationship of “the weft yarn width being larger than the warp yarn width.”

Examples 1 to 4 are of glass cloths subjected to a fiber-opening treatment by water flow under high pressure after normal weaving. As in the case of the Comparative Examples, Examples 1 to 4 also have the relationship of "the weft yarn width being larger than the warp yarn width." This relationship is also caused by the condition that no tension is exerted on the weft yarn while a given tension is exerted on the warp yarn due to the winding roll during weaving. That is, the filaments of the warp yarn hardly feaze, i.e., the yarn width hardly stretches out, even when it is subjected to a fiber opening treatment. On the contrary, the filaments of the weft yarn, which are not tensed easily, feaze by the fiber-opening treatment. The difference between the weft yarn width and the warp yarn width thus increases. This can be also seen from the fact that the occupation of the warp yarn is low while the occupation of the weft yarn is nearly 100%.

In addition, as in Example 4, when the fabric density or the diameter and the number of the filaments forming the yarn are large, the weft yarn width and the warp yarn width are close to each other in some cases since the occupation rate cannot physically exceed 100% in case the occupation is already high before the fiber-opening treatment. However, since a weft yarn is driven in and woven between warp yarns highly tensed, the waviness of the weft yarn is larger than that of the warp yarn. As a result, it is difficult to satisfy the requirement of "(d) the ratio of the elongation rate in a length direction to the elongation rate in a width direction is not less than 0.80 and not more than 1.20," even if the requirement of "(c) the ratio of warp yarn width to weft yarn width is not less than 0.80 and not more than 1.20."

In fact, Example 4 in the above table was tested and it was found that the ratio of the degrees of elongation of Example 4 was from 0.60 to 0.73. Thus the requirement

(d) above was not satisfied in this test. Enclosed is a Declaration of Mr. Fujimura confirming these test results.

With respect to the tension used during a fiber-opening treatment in conventional technology, JP 7-226571, filed in the Information Disclosure Statement of March 18, 2005, describes that the tension is 10 to 60 kg. Not more than 49 N/m(5 kg/m) in claim 6 and 4.9 N 1 m (0.5 kg/m) in the Examples in the specification are clearly lower than this. As noted above, it is difficult for a conventional weaving machine or a fiber-opening treatment machine to roll up under such a low tension. In fact, a tension control machine is needed in order to be able to roll up under such a low tension.

The above matter is confirmed by the Examples and Comparative Examples in the specification of the present application. It is described there that a glass cloth which is woven with the use of the same glass yarn (E-glass, average diameter of filament: 4.5 μm , the number of filaments: 100 and twist per a piece of the filament constituting the yarn: 1.0Z). with the same density (the number of warp yarns: 70 and that of weft yarns: 73) is produced without a fiber-opening treatment (Comparative Example 2), with a fiber-opening treatment under a tension of 4.9 N/m (Example 2), and with a fiber-opening treatment under a tension of 294 N/m(30 kg/m) (Comparative Example 3). The ratios of the warp yarn width to the weft yarn width are 0.6, 0.95 and 0.50, respectively.

That is, weaving only makes a large difference between the warp yarn width and the weft yarn width, and the difference cannot be cancelled even with a fiber-opening treatment using the tension of conventional technology (30 kg/m). However, with a fiber-opening treatment under a tension within the scope of the present invention (0.5 kg/m), the difference between the warp yarn width and the weft yarn width can be cancelled.

As described above, the glass cloth of the present invention is obtained through this new process which comprises a flattening process (fiber-opening treatment) under a low tension. It cannot be obtained by weaving and a fiber-opening treatment under the tensions used in conventional technology.

(3) The rejections based on Inoguchi in view of Nakamura and further in view of Caroselli

The Examiner points out, "Inoguchi discloses a glass cloth that is composed of a warp yarn and a weft yarn of the same glass yarn (same width)." However, as described above, this is contrary to common technical knowledge. Although the warp yarn width and the weft yarn width of a glass yarn may be the same before weaving, they are not the same after weaving or a fiber-opening treatment under the tensions used in conventional technology.

The Examiner also points out, "Inoguchi does disclose that the ratio of the tensile strength in the warp yarn direction to the tensile strength in the weft yarn direction is between 1.2 and 0.8. Therefore, it appears that the glass cloth disclosed by Inoguchi inherently possesses the claimed elongation ratio." However, the second sentence following the word "Therefore" is not correct for the following reason.

The ratio of elongation rate when a load is in a range of 25 N to 100 N is measured by the method described in paragraph [0023] of the specification, and the waviness of the yarn in a glass cloth is measured at an elongation rate with no rupture of yarn. In other words, in conventional technology, since a weft yarn is passed between warp yarns while a tension is exerted on the warp yarns, the weft yarns are undulated up and down although the warp yarns are nearly straight.

On the contrary, in the present invention the degrees of waviness of the weft yarn and the warp yarn are almost the same by the flattening process under a very low tension. The present inventors found that the evaluation of elongation rate of yarns before rupture is suitable for the evaluation of waviness.

On the other hand, the tensile strength in Inoguchi is a load at the time of the rupture of a sample of 25 mm width, and is measured by the method described in paragraph [0022] of the specification of the present application (JIS R 3420). The value by this method would be changed by the glass itself, the thermal process history thereof and stress caused by chemical treatment, not the weaving method. Since the load is measured at the time of rupture, Table 2 of Inoguchi shows large values of 20 to 83 kg (196 to 813 N)/25 mm. Moreover, since the waviness of yarn is nearly completely stretched, the strength at the time of rupture is not suitable for the evaluation of waviness.

That is, the absence of a difference between the warp yarn and the weft yarn at the time of rupture due to tension is not directly correlated with elongation rates when the waviness of the yarn is released from the exertion of tension on the weft yarn.

As described above, Inoguchi has no description or technical idea which is related to control of the tension during weaving or a fiber-opening treatment. Therefore, the glass cloth of Inoguchi is considered to have a difference between the warp yarn width and the weft yarn width or a difference between the degrees of waviness of the warp yarn and the weft yarn.

Consequently, the Examiner's opinion that the invention of Inoguchi meets the requirements (c) and (d) of the present invention, is not correct.

Conclusion

Inoguchi has no description of requirements (b), (c) and (d) of the present invention. Though the other cited references may have a description of requirement (b), they still do not have any description of either requirement (c) or (d). Consequently, the present invention cannot be considered obvious over Inoguchi even in view of the Nakamura and Caroselli. As required by M.P.E.P. §2143 to establish a prima facie case of obviousness, the cited combination of references must teach or suggest all of the claimed limitations.

Since claims 3-6 depend from claim 1, it is believed they are also unobvious over these references for the same reasons.

It is believed claims 1 and 3-6 are in condition for allowance and such action is, therefore, requested.

In view of the foregoing amendments and remarks, Applicants respectfully request reconsideration and reexamination of this application and the timely allowance of the pending claims.

Please grant any extensions of time required to enter this response and charge any additional required fees to our Deposit Account 06-0916.

Respectfully submitted,

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Dated: April 19, 2007

By: 

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Attachments: One Replacement Sheet - FIG. 1;
One Annotated Sheet Showing Changes - FIG. 1 and
Declaration of Yoshinobu Fujimura.

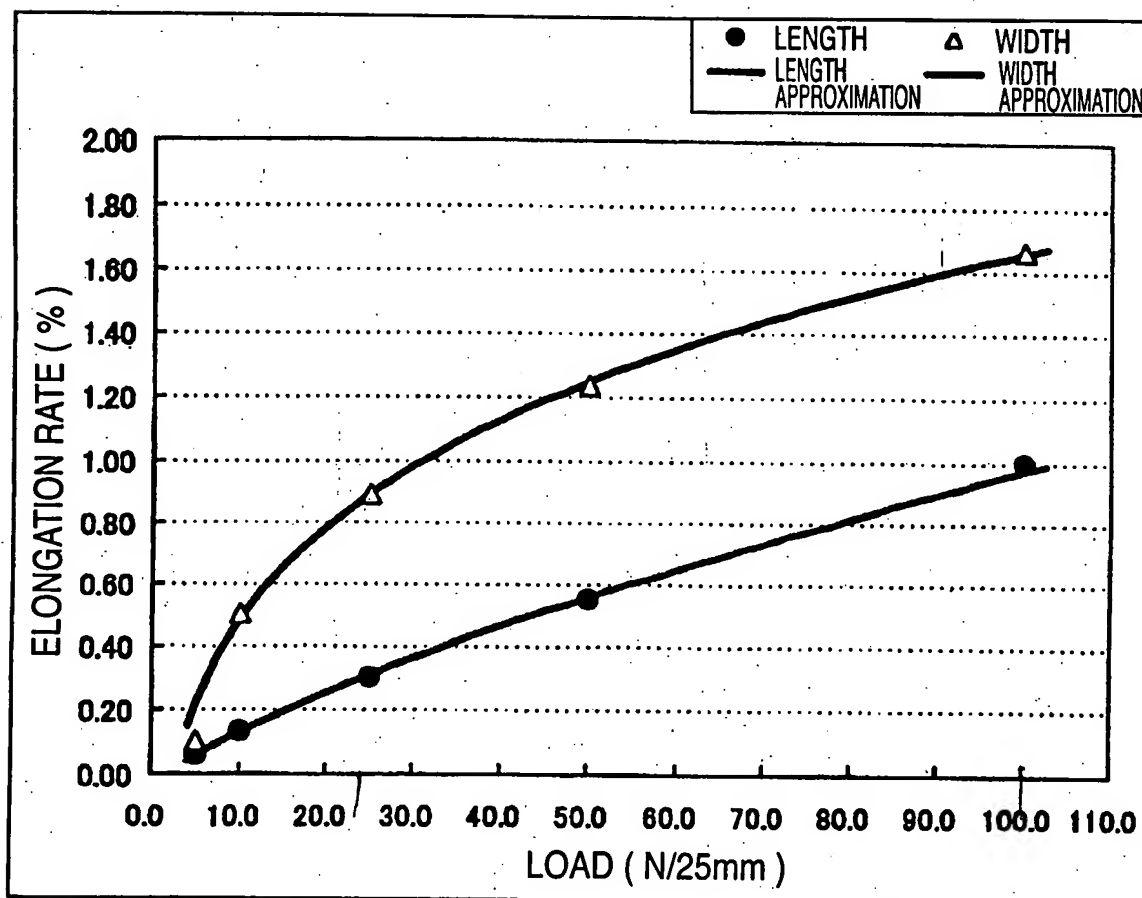
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ANNOTATED SHEET SHOWING CHANGES

1/1

FIG.1



PRIOR ART